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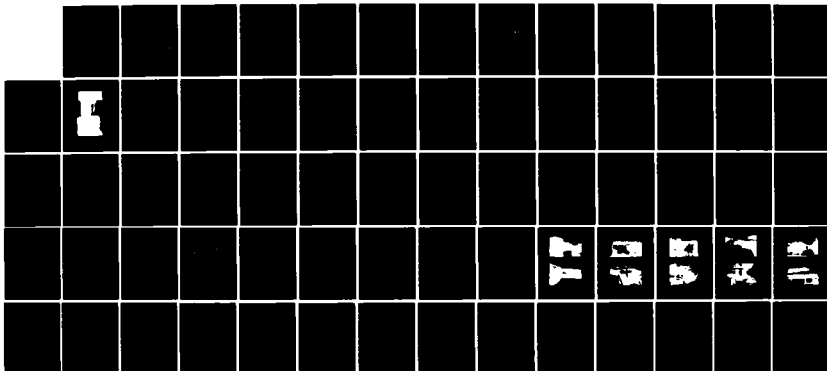
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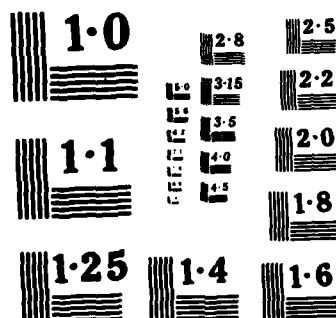
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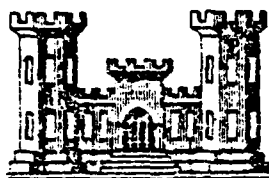
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NEW HAMPSHIRE COASTAL BASIN  
NEWMARKET, NEW HAMPSHIRE

MACALLEN DAM  
NH 00365

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
WALTHAM, MASS. 02154

MARCH 1980

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  -The dam is a run of the river dam consisting of a stone masonry spillway and concrete outlet works with earth filled abutments at either end. The facility is founded on bedrock. It is 150 ft. long with a maximum height of 27 ft. The overall condition of the dam is fair. Though few deficiencies were noted, no conditions which would warrant urgent remedial action were found. It is intermediate in size with a significant hazard potential.		

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DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
424 TRAPELO ROAD  
WALTHAM, MASSACHUSETTS 02154

REPLY TO  
ATTENTION OF  
NEDED

JUL 22 1980

Honorable Hugh J. Gallen  
Governor of the State of New Hampshire  
State House  
Concord, New Hampshire 03301

Dear Governor Gallen:

Inclosed is a copy of the Macallen Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Essex Group Subsidiary of United Technologies, Bay Road, Newmarket, New Hampshire 03857.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely,

  
MAX B. SCHEIDER

Colonel, Corps of Engineers  
Division Engineer

Incl  
As stated

NEW HAMPSHIRE COASTAL BASIN  
 NEWMARKET, NEW HAMPSHIRE

MACALLEN DAM  
 NH 00365

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PHASE I INSPECTION REPORT  
 NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY  
 NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
 WALTHAM, MASS. 02154

APRIL 1980

NATIONAL DAM INSPECTION PROGRAM  
PHASE I INVESTIGATION REPORT

Identification No.:	NH 00365
Name of Dam:	Macallen
Town:	Newmarket
County and State:	Rockingham, New Hampshire
Stream:	Lamprey River
Date of Site Visit:	16 November 1979

BRIEF ASSESSMENT

Macallen Dam is a run-of-the-river dam consisting of a stone masonry spillway and concrete outlet works with earth filled abutments at either end. The spillway weir is broad crested with no means of affixing flashboards to it. The outlet works have three motor operated waste gates and forms the left end of the spillway. The crest length of Macallen Dam is 150 ft. with a height of about 27 ft. A fishladder built in 1971, forms the right spillway training wall. The facility is founded on bedrock.

Due to the extent of downstream development that would be affected in the event the dam were to fail, Macallen Dam has been determined to have a "significant" hazard potential classification in accordance with Corps of Engineers guidelines.

The dam is in good condition, based on visual examination of the structure. However, because the dam is located within Seismic Zone 3 and the stability of the dam under seismic loading is unknown, the project is considered to be in fair condition overall. Though a few deficiencies were noted, there was no evidence of settlement, lateral movement or other signs of structural failure, or conditions which would warrant urgent remedial action.

Based on the "intermediate" size and "significant" hazard potential classifications, in accordance with Corps of Engineers guidelines, the adopted test flood for this dam is 1/2 the Probable Maximum Flood (1/2 PMF). With the water level at the top of dam, the spillway capacity is approximately 3,600 cfs or about 50 percent of the routed test flood outflow and the outlet works capacity is 3,120 cfs. Hydraulic analyses indicate that the routed test flood outflow of 7,250 cfs (inflow 7,350 cfs or 35 csm) would overtop the dam by 0.5 ft.

Essex Group Subsidiary of United Technologies, owner of the dam, should engage a registered professional engineer qualified



in the design and construction of dams to determine the seismic stability of the structure, as outlined in Section 7.2. Any necessary modifications to the structure resulting from the investigation and remedial measures, including repairing the lift mechanism of the center waste gate and the monitoring of the slight seepage along the right wall of the downstream channel, as outlined in Section 7.3, should be implemented by the Owner within one year after receipt of this report. The Owner should also prepare a formal operations and maintenance manual for the dam and establish an emergency preparedness plan and downstream warning system.

HALEY & ALDRICH, INC.  
by:



Harl Aldrich  
President



This Phase I Inspection Report on Macallen Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER  
Design Branch  
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER  
Water Control Branch  
Engineering Division

Aramast Mahtesian

ARAMAST MAHTESIAN, CHAIRMAN  
Geotechnical Engineering Branch  
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar  
JOE B. FRYAR  
Chief, Engineering Division

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the office of Chief of Engineers, Washington, DC 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm run-off), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential. Consideration of downstream flooding other than in the event of a dam failure is beyond the scope of this investigation.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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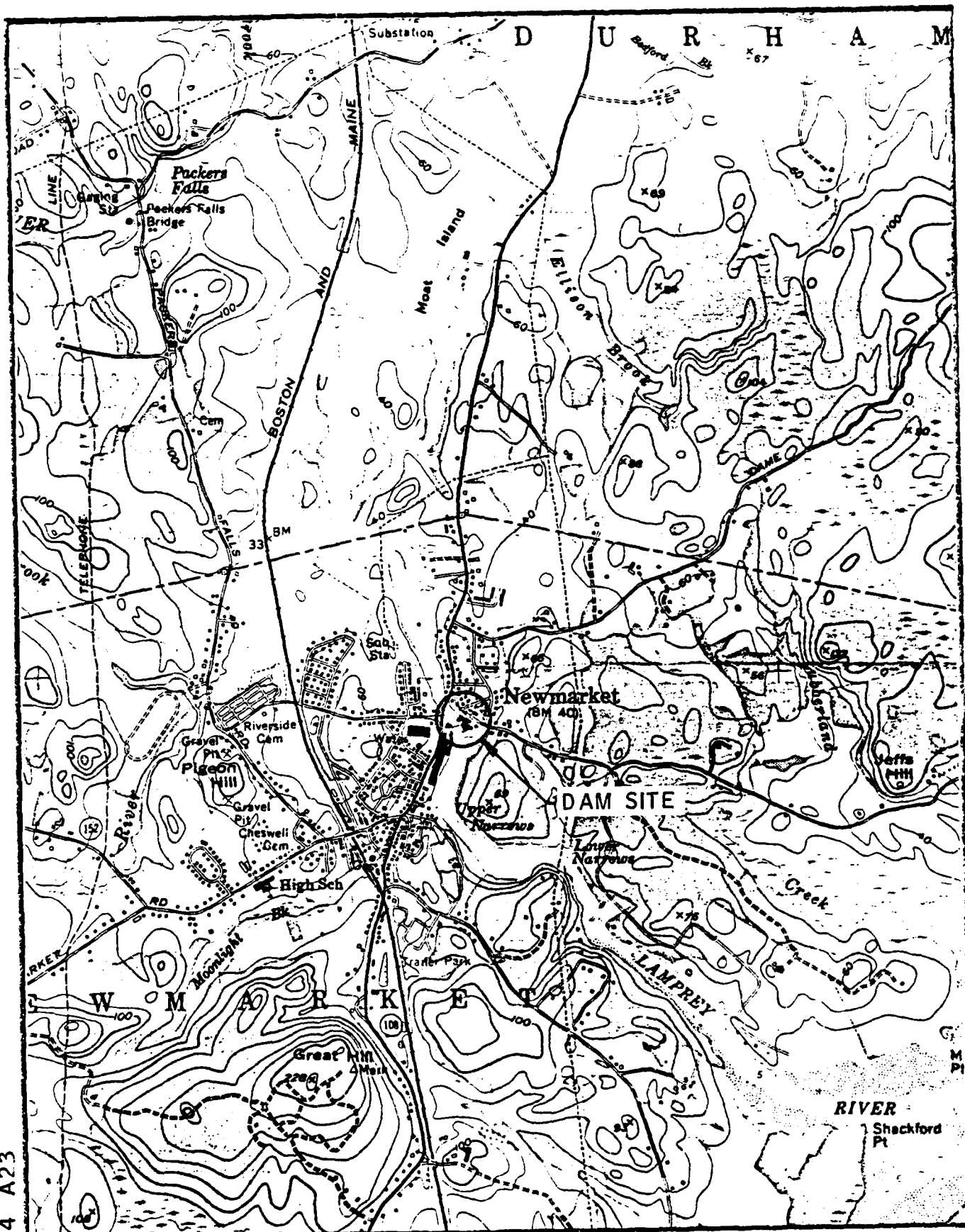
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1. Overview of Macallen Dam showing upstream side

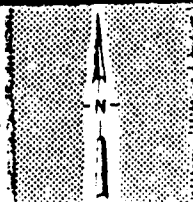


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DAM: Macallen

IDENTIFICATION NO. N H 00365



LOCATION MAP  
U.S.G.S. QUADRANGLE  
NEWMARKET, NH  
APPROX. SCALE: 1" = 2000'

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM

MACALLEN DAM  
NH 00365

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region.

Haley & Aldrich, Inc. has been retained by the New England Division to inspect and report on selected dams in the States of New Hampshire and Maine. Authorization and notice to proceed were issued to Haley & Aldrich, Inc. under a letter dated 31 October 1979 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW33-80-C-0009 has been assigned by the Corps of Engineers for this work. Camp, Dresser & McKee, Inc. was retained as consultant to Haley & Aldrich, Inc. on the structural, mechanical/electrical and hydraulic/hydrologic aspects of the Investigation.

b. Purpose of Inspection. The primary purposes of the National Dam Inspection Program are to:

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and prepare the states to initiate effective dam safety programs for non-Federal dams.

3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Macallen Dam is located on the Lamprey River in Newmarket, New Hampshire, Rockingham County, as shown on the Location Map, page vii. The latitude and longitude

of the dam site are  $N43^{\circ}04.9'$  and  $W70^{\circ}56.1'$ , respectively. The downstream channel is a tidal portion of the Lamprey River that outlets approximately 1.5 mi. downstream into Great Bay.

b. Description of Dam and Appurtenances. Macallen Dam consists of a stone masonry spillway and concrete outlet works with earth filled abutments at either end. The overall length of the dam, as recorded in prior State of New Hampshire inspection reports, is 150 ft. This distance is measured from the left end of the outlet works to the far end of the concrete headwall that forms the right dam abutment. The height of the dam is about 27 ft.

The spillway is a broad crested old stone masonry structure. The spillway weir is 68 ft. long with no apparent means of affixing flashboards to it. However, the spillway once supported 3 ft.-9 in. of flashboards. A concrete fish-ladder on the right end of the spillway serves as training wall for the spillway. The left spillway training wall is formed by the outlet works. The facility is founded on bedrock.

The outlet works has three motor operated waste gates. Each gate measures about 7 ft. by 7 ft. square. The structure has an overall length of about 27 ft. along the axis of the dam.

The downstream channel has an exposed bedrock bottom with masonry walls which are common to old mill buildings located along the channel. Two bridges cross the downstream channel and connect the old mill buildings on either side of the dam.

c. Size Classification. The storage to the top of Macallen Dam is estimated to be 1,740 acre-ft., and the corresponding hydraulic height of the dam is approximately 27 ft. Storage of from 1,000 to 50,000 acre-ft. and/or a height of from 40 to 100 ft. classifies a dam in the "intermediate" size category, according to the guidelines established by the Corps of Engineers. Although the height of the dam is less than 40 ft., it is classified as an "intermediate" size dam by virtue of its storage capacity.

d. Hazard Classification. Dam failure analysis computations in Appendix D, which are based on Corps of Engineers "Guidance for Estimating Downstream Dam Failure Hydrographs", demonstrate why this dam has been determined to have a "significant" hazard potential classification. Substantial flooding

would be occurring prior to dam failure and an estimated two or three structures would be impacted as a result of the increase in flow from a failure of Macallen Dam. The potential loss of life would be a few.

e. Ownership. The name, address and phone number of the current owner of the Macallen Dam are:

Essex Group Subsidiary of United  
Technologies  
Bay Road  
Newmarket, New Hampshire 03857  
(603) 659-5555

The above company, which also is listed as the Macallen Company, became owner of the dam in 1969. A substantial tract of land and the fishladder on the right side of the dam is owned by the New Hampshire Fish and Game Department.

f. Operator. Mr. Leo Fillion with Essex Group, has been responsible for operation, maintenance and safety of the dam since 1966. His phone number is (603) 659-5555. The fishladder is operated by personnel of the New Hampshire Fish and Game Department.

g. Purpose of Dam. The Macallen Dam was previously used for hydroelectric power generation. The power generating capabilities of the facility were last employed in about 1955. Since that time the river flow has been used for the processing needs of different companies that have occupied the old mill buildings at the site. The only formal use of the retained water, presently, is for fire protection and industrial processing at the factory located left of the dam.

h. Design and Construction History. There are no design or construction records available to document how and by whom the original dam was built.

i. Normal Operational Procedures. There are no formal procedures for the regulation of the waste gates. In general, the gates are opened in response to flow. The Operator reported that when the head over the spillway is approximately 18 in., one gate is opened so as to maintain about 12 in. of water depth over the spillway. If it is not possible to achieve the 12 in. depth with one gate open, then the second and if necessary third gates are opened.

### 1.3 Pertinent Data

All elevations reported herein are approximate and based

on an assumed datum given on drawings prepared for the construction of the fishladder, at the right side of the dam, by the New Hampshire Fish and Game Department. Based on the assumed datum, the crest of the spillway weir is at El. 100.0.

Records, of a petition hearing by the New Hampshire Public Service Commission on 17 December 1935, give a spillway crest elevation of 24.19 ft. above sea level. The datum from which this elevation was taken could not be verified. However, the spillway crest elevation is believed to be close to this elevation based on NGVD.

a. Drainage Area. Several small streams draining Saddleback Mountain and the surrounding hills combine to form the Lamprey River in the central and eastern portion of Northwood, New Hampshire. From its source the river flows generally eastward to Epping where the river continues in a northeasterly direction into Lee and Durham. Finally, the river flows in a southeasterly direction through Newmarket to its mouth in Great Bay. The river has a total length of approximately 42 mi., a drainage area of 211 sq. mi., and a total fall of 600 ft. The river is tidal up to the Macallen Dam located in Newmarket where the drainage area is 210 sq. mi. The major tributaries to the Lamprey River are the Pawtuckaway, Piscassic, Little and North Rivers.

b. Discharge at Dam Site

1. Outlet works (water level at top of dam)
  - One gate open..... 1,040 cfs
  - Two gates open..... 2,080 cfs
  - Three gates open..... 3,120 cfs
2. Maximum known flood at dam site..... 5,900 cfs (Est.) on 20 March 1936. U/S  
USGS Gauge recorded 5,490 cfs
3. Ungated spillway capacity at top of dam..... 3,600 cfs at El. 105.9
4. Ungated spillway capacity at test flood pool elevation..... 4,080 cfs at El. 106.4
5. Gated spillway capacity at normal pool elevation..... Not applicable
6. Gated spillway capacity at test flood pool elevation..... Not applicable
7. Total spillway capacity at test flood pool elevation..... 4,080 cfs at El. 106.4

8. Total project discharge at  
test flood pool elevation..... 7,250 cfs at El. 106.4

c. Elevation (Assumed Datum, not NGVD)

1. Streambed at centerline of dam.	79.0
2. Maximum tailwater.....	93.0
3. Upstream portal invert diversion tunnel.....	Not applicable
4. Normal river stage.....	100.0
5. Full flood control pool.....	Not applicable
6. Spillway crest.....	100.0
7. Design surcharge - original design.....	Unknown
8. Top of dam.....	105.9
9. Test flood surcharge.....	106.4

d. Length of Reservoir (mi. estimated)

1. Normal pool.....	2.6
2. Flood control pool.....	Not applicable
3. Spillway crest pool.....	2.6
4. Top of dam.....	2.6
5. Test flood pool.....	2.6

e. Storage (acre-ft.)

1. Normal pool.....	480
2. Flood control pool.....	Not applicable
3. Spillway crest.....	480
4. Top of dam.....	1,740
5. Test flood pool.....	1,860

f. Reservoir Surface (acres)

1. Normal pool.....	120
2. Flood control pool.....	Not applicable
3. Spillway crest.....	120
4. Top of dam.....	300
5. Test flood pool.....	330

g. Dam

1. Type.....	Gravity; stone and concrete masonry with masonry retained earth at ends
2. Crest length.....	150 ft.
3. Height.....	27 ft.
4. Top width.....	Varies
5. Side slopes.....	Unknown - exposed walls appear vertical

- 6. Zoning..... Unknown
- 7. Impervious core..... Unknown
- 8. Cutoff..... Founded on ledge
- 9. Grout curtain..... Probably none

h. Diversion and Regulating Tunnel      Not applicable

i. Spillway

- 1. Type..... Stone masonry broad crested weir
- 2. Length of weir..... 68 ft.
- 3. Crest elevation..... 100.0
- 4. Gates..... None
- 5. U/S channel..... Lamprey River
- 6. D/S channel..... Lamprey River tidal from dam to Great Bay
- 7. General..... Right abutment of spillway incorporates a concrete fishladder

j. Regulating Outlets. The outlet works is located at the left abutment of the spillway and consists of three motor operated waste gates. Each gate is approximately 7 ft. square and their invert elevation is about 7 ft. below the crest of the spillway. The control panel for each gate motor operator is located at the top of the outlet works platform.

## SECTION 2 - ENGINEERING DATA

### 2.1 Design Data

No design data for the original dam were located and none are believed to exist.

### 2.2 Construction Data

Based on information obtained from the files of the New Hampshire Water Resources Board in Concord, New Hampshire, it is believed that the dam was constructed in 1887. However, no engineering data concerning the construction of the dam were disclosed.

### 2.3 Operation Data

No operational data, other than prior inspection reports on the facility, were located.

### 2.4 Evaluation of Data

a. Availability. A list of engineering data available for use in preparing this report is included on page B-1. Selected documents from the listing are also included in Appendix B.

b. Adequacy. There was a lack of engineering data available to aid in the evaluation of Macallen Dam. This Phase I assessment was, therefore, based primarily on visual examination, preliminary hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement.

c. Validity. In general, the available data located were not applicable to an engineering evaluation of the dam.



## SECTION 3 - VISUAL EXAMINATION

### 3.1 Findings

a. General. The Phase I visual examination of Macallen Dam was conducted on 16 November 1979. The upstream water surface elevation was about 1.7 ft. above the spillway crest that day. Based on visual observations made during the examination, the project is considered to be in good condition. A few deficiencies which require correction were noted.

A visual inspection check list is included in Appendix A and selected photographs of the project are given in Appendix C. A "Site Plan Sketch", page C-1, shows the direction of view for each photograph.

b. Dam. Macallen Dam, the spillway and walls retaining the earth fill, appear to be in good condition, Photos Nos. 2 and 3. The spillway was free of debris. However, there was a partially sunken log in the approach channel, Photo No. 1, which had been viewed at the same location during a prior visit to the site on 8 September 1979.

No significant settlement, displacement or distressed stone work were observed during the site examination nor was any indication of significant distress in the concrete outlet works noted, Photo No. 5. The filled pool and flow over the weir precluded a close examination of the upstream face of the dam and downstream face of the weir, Photo No. 9.

c. Appurtenant Structures. The stone masonry walls of the downstream channel appeared to be sound and in good condition, Photos Nos. 4 and 6. However, slight seepage was observed moistening the top surface of the lower stone masonry building wall adjacent to the fishladder (see Appendix page C-1). The water was clear and the slight flow appeared to be constant. The seepage may be from a filled canal within the right abutment area, from natural drainage or from some other source.

The fishladder, Photo No. 7, is in excellent structural condition with only minor efflorescence and seepage at shrinkage cracks and joints. The only significant item noted with respect to the fishladder was that the grating near the entrance to the ladder is lacking support.

The outlet works consist of three electrically powered double stem gates at the left abutment of the dam. Each of the gates is approximately 7 ft. by 7 ft. in size and are

contained in a concrete structure constructed after the original dam. The motor control center for the gates is on the operating platform above the gates. There are provisions for stoplogs at the upstream side of the three gates. The left and right gates are operational and were tested during the inspection. The center gate lifting mechanism was not operational and was under repair at the time of inspection.

d. Reservoir Area. The impounded portion of the Lamprey River extends upstream of the dam approximately 2.6 mi. to Packers Falls. Included in this impoundment is the confluence of the Piscassic River with the Lamprey River. Approximately 350 ft. upstream of the dam is the Route 103 Bridge which constitutes a restriction to the river as it approaches the dam, Photo No. 10. It is reported that the construction causes the upstream water surface to be somewhat higher than the actual head water measured at the dam during peak spring discharges. Existing development along the upstream impoundment is reportedly subject to minor flooding in the spring during peak flows.

e. Downstream Channel. The Lamprey River flows approximately 1.5 mi. from the dam to Great Bay and is tidal for the entire length. Existing development along the river, downstream of Newmarket, is sparse. The Owner's old mill buildings are located immediately downstream of the dam on both banks, Photo No. 11. A small, low lying section of Newmarket, consisting of 5 or 6 structures, is located on the right bank just downstream of the mill complex.

### 3.2 Evaluation

Based on the visual examination conducted on 16 November 1979, the Macallen Dam was found to be in good condition. However, the recommendations and remedial measures outlined in Sections 7.2 and 7.3, respectively, should be implemented to correct the noted deficiencies in the available data, and the dam and fish-ladder.

## SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

### 4.1 Operational Procedures

a. General. In general, there are no formal procedures for the operation of the dam.

b. Description of Any Warning System in Effect. There is no warning system or emergency preparedness plan in effect for this structure.

### 4.2 Maintenance Procedures

a. General. There are no established procedures or manuals for inspection and maintenance of the dam. Remedial measures pertaining to the dam and outlet works are performed by the Owner on an as needed basis. Operation and maintenance of the fishladder are performed by personnel of the New Hampshire Fish and Game Department.

b. Operating Facilities. The spillway structure does not have flashboards or stoplogs. There is no formal plan to maintain the outlet works and controls or to keep the discharge channel free of debris. The gate motor operators are periodically serviced and are maintained in operating condition. The outlet works are reportedly opened every spring. Two of the gates were partially opened during the site visit. The third gate (center) lifting device was under repair during the time of inspection precluding its operation.

### 4.3 Evaluation

The Owner should prepare an operations and maintenance manual for the dam. The manual should delineate the routine operational procedures and maintenance work to be done on the dam to provide satisfactory operation and minimize deterioration of the facility. For example, an annual observation and maintenance program should be established to examine the dam, control vegetation growth, and maintain the walls and channels. Incorporated in this manual should be a procedure to operate the waste gates periodically.

Since failure of the dam would probably cause loss of life and property damage downstream, the Owner should also prepare and implement a formal emergency preparedness plan and warning system.

## SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

### 5.1 General

The Macallen Dam is a run-of-the-river dam located on the Lamprey River. The drainage area tributary to the dam is about 210 sq. mi. of flat and coastal terrain which is tributary to Great Bay. The Lamprey River is tidal from the toe of Macallen Dam to its confluence with Great Bay, a reach length of about 1.5 mi. The dam impounds approximately 2.6 mi. of the Lamprey River upstream to Packers Falls. The stone masonry dam consists of an uncontrolled 68 ft. long spillway with three 7-ft. square motor operated waste gates at the left end and a concrete fishladder at the right end. The top of dam, measured at the right spillway training wall, is 5.9 ft. above the spillway crest.

### 5.2 Design Data

There is no hydraulic/hydrologic design data available for the dam.

### 5.3 Experience Data

No records of historical floods at the dam site were located. The flood of record for the Lamprey River, measured at USGS Gage No. 01073500 located approximately 2.7 mi. upstream and having a drainage area of 183 sq. mi., was 5,490 cfs on 20 March 1936. By proportioning the drainage areas, this flood of record translates to an estimated flow of 5,900 cfs at the Macallen Dam.

### 5.4 Test Flood Analysis

Based on the Corps of Engineers Guidelines, the recommended test flood range for the size "intermediate" and hazard potential "significant" is the 1/2 PMF to a full PMF (Probable Maximum Flood). The 1/2 PMF was selected for the test flood as the size of the facility places it near the low end of the classification range. The 1/2 PMF was determined using the Corps of Engineers Guidelines for "Estimating Maximum Probable Discharge" in Phase I Dam Safety Investigations. The 210 sq. mi. watershed tributary to Macallen Dam is typical of flat and coastal terrain with extensive

natural flood plain storage. The total fall of the Lamprey River is only 600 ft. over its total length of about 40 mi. Having similar characteristics to the Charles River watershed, a peak inflow rate of 35 csm was selected for the 1/2 PMF inflow. This results in a test flood inflow of 7,350 cfs.

Surcharge storage routing of the test flood inflow was performed with almost negligible results due to the minimal upstream storage as compared to the size of the drainage area. The routed test flood outflow is 7,250 cfs at stage elevation 106.4 or about 0.5 ft. above top of dam. The maximum project discharge capacity computed during the inspection is 6,720 cfs with water at top of dam and all wastegates open. The spillway capacity at top of dam (excluding capacity of waste gates) is 3,600 cfs or about 50 percent of the routed test flood outflow.

#### 5.5 Dam Failure Analysis

Dam failure analysis was performed assuming that the entire 68 ft. length of spillway fails above the height of tailwater during a maximum project discharge (river at top of dam) of 7,250 cfs. The resulting dam failure outflow is 9,450 cfs or 2,200 cfs greater than the flow occurring prior to failure. Existing development downstream of the dam, which is not located on high ground, would be subject to flooding prior to a failure. The increase in hazard resulting from a failure would be limited to two or three additional structures located on the right bank just downstream of the Owner's old mill buildings. The increase in flooding depths due to a dam failure would be in the range of 1 to 3 ft. Consequently, the potential exists for additional loss of life over that of a natural flooding event.

The potential loss of life resulting from a dam failure would be a few and the dam is accordingly classified in the "significant" hazard category.

## SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

### 6.1 Visual Observations

There was no visual evidence of settlement, lateral movement or other signs of structural instability in the dam during the site examination. However, the spillway was obscured by flowing water during the site examination making a detail examination impractical. Based on those conditions that were observed, no reason was found to question the static structural stability of the dam.

### 6.2 Design and Construction Data

No design or construction data were located for this dam. Correspondence and applications indicate that the spillway supported approximately 3 ft.-9 in. of flashboards in the past and therefore the dam has probably been subjected to hydrostatic loads at or near its crest in the past. Based on the observed conditions and past performance of the dam, it is considered to be adequately stable under normally anticipated static loadings with no flashboards.

### 6.3 Post-Construction Changes

The outlet works is constructed of concrete and has an imbossed date on it of 1925 while the major portion of the dam is constructed of stone masonry and reported to have been built in 1887. Old property drawings show a canal through the right abutment area while the observed conditions, during the site examination, indicate that this same area contains earth fill. The intake and canal in the left abutment area was reported, by the Owner's representative, to be bulkheaded. A relatively new concrete fishladder with a dedication date of 1971 is located at the right end of the spillway. The effect of these post-construction changes on the stability of the dam is unknown.

### 6.4 Seismic Stability

Macallen Dam is located within Seismic Zone 3 and in accordance with Recommended Phase I Guidelines, suitable analysis relative to seismic stability should be on record. The pertinent data required for a seismic analysis appears not to be readily available and no record of such studies were located. Therefore, the stability of the dam under seismic loading is unknown.

## SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

### 7.1 Dam Assessment

a. Condition. The visual examination of Macallen Dam revealed that the structure was in good condition. However, due to the lack of information on the stability of the dam under seismic loading, the project is considered to be in fair condition overall. Though there were no signs of impending structural failure or other conditions which would warrant urgent remedial action, a few deficiencies were noted.

Based on the results of computations included in Appendix D and described in Section 5, the facility is not capable of passing the adopted test flood, which for this structure is the 1/2 PMF, without overtopping the dam. With the water level at the top of the dam, the spillway capacity is approximately 3,600 cfs or about 50 percent of the routed test flood outflow and the outlet works capacity is about 3,120 cfs. The routed test flood outflow of 7,250 cfs (inflow of 7,350 cfs or 35 csm) would overtop the dam by about 0.5 ft.

b. Adequacy of Information. This evaluation of the dam is based primarily on visual examination, preliminary hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement. Generally the information available or obtained was adequate for the purposes of a Phase I assessment. However, it is recommended that additional information regarding the seismic stability of the dam, as outlined in Section 7.2, be obtained.

c. Urgency. The recommendations for additional investigations and remedial measures outlined in Sections 7.2 and 7.3, respectively, should be undertaken by the Owner and completed within one year after receipt of this report.

### 7.2 Recommendations

It is recommended that the Owner engage a registered professional engineer qualified in the design and construction of dams to undertake the following investigations:

1. Perform a dynamic structural analysis of the dam to determine its seismic stability.
2. Perform a hydrologic/hydraulic investigation to determine the need and means of increasing the discharge capacity of the facility.

3. Inspect the dam and appurtenant structures during a period of low flow when the downstream face of the spillway is exposed.

The Owner should then implement corrective measures on the basis of this engineering evaluation.

### 7.3 Remedial Measures

Although the dam is considered to be in fair condition overall, it is important that the following items be accomplished.

a. Operation and Maintenance Procedures. The following should be undertaken by the Owner:

1. Complete the repairs on the operating mechanism of the center waste gate.
2. Monitor the slight seepage along the right wall of the downstream channel such that the flow can be correlated with reservoir level. If the seepage flow is noted to increase without apparent reason, the Owner should then engage a registered professional engineer to investigate the condition. All observations should be made part of a permanent record.
3. The New Hampshire Fish and Game Department should modify the grating near the entrance to the fishladder to provide adequate support to the grating.
4. Prepare an operations and maintenance manual for the dam. The manual should include provisions for annual technical inspection of the dam and for round-the-clock surveillance of the dam during periods of heavy precipitation and high project discharges. The procedures should delineate the routine operational procedures and maintenance work to be done on the dam to ensure safe, satisfactory operation and to minimize deterioration of the facility. The operations manual should include instructions on the opening of the waste gates at specific water levels and at what water levels the various gates are to be closed.
5. Develop a written emergency preparedness plan and warning system to be used in the event of impending failure of the dam or other emergency conditions. The plan should be developed in cooperation with local officials and downstream inhabitants.

### 7.4 Alternatives

There are no practical alternatives to the above recommendations.



APPENDIX A - INSPECTION CHECK LIST

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<u>VISUAL INSPECTION PARTY ORGANIZATION</u>	A-1
<u>VISUAL INSPECTION CHECK LIST</u>	
Dam Embankment	A-2
Outlet Works - Intake Channel and Intake Structure	A-2
Outlet Works - Control Platform	A-2
Outlet Works - Outlet ..	A-3
Outlet Works - Spillway Weir, Approach and Discharge Channels	A-3

VISUAL INSPECTION PARTY ORGANIZATION  
NATIONAL DAM INSPECTION PROGRAM

Dam: Macallen

Date: 16 November 1979

Time: 0745-1015

Weather: Partly cloudy and cold (approx. 30°F)  
(light snow shower at 0900)

Water Surface Elevation Upstream: El. 101.7 - Assumed datum  
(1.7 ft. above top of spill-  
way weir)

Stream Flow: Unknown

Inspection Party:

Harl P. Aldrich, Jr.	-	Soils/Geology
Charles R. Nickerson		
Haley & Aldrich, Inc.		
Roger H. Wood	-	Structural/Mechanical
Joseph E. Downing	-	Hydraulic/Hydrologic
Camp, Dresser & McKee, Inc.		

Present During Inspection:

Kenneth T. Stern, New Hampshire Water Resources Board  
Stephen A. Virgin, New Hampshire Fish and Game Department  
Leo Fillion, Essex Group Subsidiary of United Technologies

# VISUAL INSPECTION CHECK LIST NATIONAL DAM INSPECTION PROGRAM

DAM: Macallen

DATE: 16 Nov. 79

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	(No associated earth embankment for this dam)
Spillway Crest Elevation	El. 100.0 (based on assumed datum; see text)
Current Pool Elevation	El. 101.7
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u>	
a. <u>Approach Channel</u>	Intake right at river
Slope Conditions	Not applicable
Bottom Conditions	Not visible
Rock Slides or Falls	None observed
Log Boom	None observed
Debris	Clear of debris
Condition of Concrete Lining	Not applicable
Drains or Weep Holes	Not applicable
b. <u>Intake Structure</u>	
Condition of Concrete	Very good
Stoplogs and Slots	Stoplog slots in very good condition (concrete only, no metal observed)
<u>OUTLET WORKS - CONTROL PLAT-FORM</u>	
a. <u>Concrete and Structural</u>	
General Condition	Good
Condition of Joints	Not applicable
Spalling	No major spall observed
Visible Reinforcing	None observed
Rusting or Staining of Concrete	None observed
Any Seepage or Efflorescence	None observed
Joint Alignment	Not applicable
Unusual Seepage or Leaks in Gate Chamber	Not visible
Cracks	Minor shrinkage cracks
Rusting or Corrosion of Steel	Some rust on metalwork

A-2

FILE NO 4454

# VISUAL INSPECTION CHECK LIST

## NATIONAL DAM INSPECTION PROGRAM

DAM: Macallen Dam

DATE: 16 Nov. 79

AREA EVALUATED	CONDITION
b. <u>Mechanical and Electrical</u>	
Service Gates	Left and right gates are operational. Middle gate lifting mechanism currently is under repair
Lightning Protection System	None observed
Wiring System at Gate Chamber	Serviceable
<u>OUTLET WORKS - OUTLET</u>	
General Condition of Concrete	Good
Rust or Staining	None observed
Spalling	Surface coating coming off (minor film) Right side concrete facing on stone masonry cracked
Erosion or Cavitation	No major condition noted
Visible Reinforcing	None observed
Any Seepage or Efflo- rescence	No major condition noted
Condition at Joints	Not applicable
Drain Holes	None observed
Channel	Clear
Loose Rock or Trees Overhanging Channel	No trees. Rock face on left side is steep and may have some loose pieces (not accessible for detailed check)
Condition of Discharge Channel	Very good
<u>OUTLET WORKS - SPILLWAY</u>	
<u>WEIR, APPROACH AND</u>	
<u>DISCHARGE CHANNELS</u>	
a. <u>Approach Channel</u>	
General Condition	Clear but one broken tree floating in approach and one broken tree along bank
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	None observed
Floor of Approach Channel	Not visible

A-3

# **VISUAL INSPECTION CHECK LIST** **NATIONAL DAM INSPECTION PROGRAM**

**DAM:** Macallen Dam

**DATE:** 16 Nov. 79

AREA EVALUATED	CONDITION
<p>b. <u>Weir and Training Walls</u></p> <p>General Condition of Concrete</p> <p>Rust or Staining</p> <p>Spalling</p> <p>Any Visible Reinforcing</p> <p>Any Seepage or Efflorescence</p> <p>Drain Holes</p>	<p>Weir not visible due to flow. Alignment and crest elevation appeared good</p> <p>Open joint masonry walls in good condition</p> <p>None observed</p> <p>No major area of missing rock observed</p> <p>Not applicable</p> <p>Slight seepage at right wall. Conditions did not allow left wall to be detailed checked</p> <p>Not applicable</p>
<p>c. <u>Discharge Channel</u></p> <p>General Condition</p> <p>Loose Rock Overhanging Channel</p> <p>Trees Overhanging Channel</p> <p>Floor of Channel</p>	<p>Good</p> <p>Rock appeared reasonably sound</p> <p>None observed</p> <p>Clear except for some scattered rock debris</p>
<p>d. <u>Fish Ladder</u></p>	<p>Slight efflorescence at shrinkage cracks. Some seepage at joints. Grating at entrance to ladder is spanning in the wrong direction. Otherwise the structure is in excellent condition.</p>

FILE NO 4454

## APPENDIX B - ENGINEERING DATA

	<u>Page</u>	
<u>LIST OF AVAILABLE DATA</u>	B-1	
<u>PRIOR INSPECTION REPORTS</u>		
<u>Date</u>	<u>Description</u>	
19 April 1939	New Hampshire Water Control Commission	B-3
28 September 1949	New Hampshire Water Control Commission	B-5
20 April 1977	New Hampshire Water Resources Board	B-6
<u>DRAWINGS</u>		
"Newmarket Mfg. Co., Water Power Property, Showing Division Lines and Rights of Way", John W. Durgin, Civil Engineer, 19 September 1933		B-10
"Proposed Lamprey River Fish Ladder, Newmarket, N.H.", New Hampshire Fish & Game Department, Concord, N.H., January 1971		B-11

LIST OF AVAILABLE DATA  
Macallen Dam

<u>Document</u>	<u>Contents</u>	<u>Location</u>
Department of the Interior, United States Geological Survey, Report on Developed Water Power	Report on dam and hydroelectric capabilities dated 23 July 1920	Water Resources Board State of New Hampshire 37 Pleasant Street Concord, New Hampshire 03301
Public Service Commission of New Hampshire - Dam Record	Four items concerning dam owner- ship and inspection of dam dated 26 September 1935	Water Resources Board State of New Hampshire
New Hampshire Public Ser- vice Commission, Question- naire-Statement, Concerning Mills and their repairs, Dams and Flowage	Four items concerning Chapter 218, Public Laws of New Hampshire and associated in- formation dated from 15 April 1936 to 19 September 1936	Water Resources Board State of New Hampshire
New Hampshire Water Control Commission, Data on Dams in New Hampshire	Two sheets on inspection in- formation of dam dated 19 April 1939	Water Resources Board State of New Hampshire (See Appendix pages B-3 and B-4)
New Hampshire Water Re- sources Board, Question- naire, Water Power of New Hampshire	Questionnaire filled out by H.J. Waldron for Association Gas & Light Co. dated 10 July 1942	Water Resources Board State of New Hampshire
New Hampshire Water Control Commission, Report on Dam Inspection	Inspection report dated 28 September 1949	Water Resources Board State of New Hampshire (See Appendix page B-5)
Correspondence between New Hampshire Electric Company and Water Resources Board	Three letters concerning "Power in New Hampshire" sur- vey dated from 7 to 31 December 1951	Water Resources Board State of New Hampshire

LIST OF AVAILABLE DATA  
Macallen Dam  
 (continued)

<u>Document</u>	<u>Contents</u>	<u>Location</u>
Robert W. Livingston memo to Vernon A. Knowlton, Water Resources Board	Memo on complaint of flooding caused by Macallen Dam dated 13 February 1970	Water Resources Board State of New Hampshire
New Hampshire Water Resources Board, Inspection Report	Four page inspection report with photograph, dated 20 April 1977	Water Resources Board State of New Hampshire (See Appendix pages B-6 through B-9)

:



NEW HAMPSHIRE WATER CONTROL COMMISSION  
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION

STATE NO. 177.01

Town New Center: County Rockingham  
Stream Longway R.  
Basin-Primary 222.2: Secondary 212.2  
Local Name  
Coordinates—Lat. 42° 51' - 300: Long. 70° 31' 4.4950

GENERAL DATA

Drainage area: Controlled.....Sq. Mi.: Uncontrolled..... Sq. Mi.: Total 212 Sq. Mi.  
Overall length of dam 150 ft.: Date of Construction  
Height: Stream bed to highest elev. 32 ft.: Max. Structure 30 ft.  
Cost—Dam: Reservoir

DESCRIPTION Gravity split stone concrete earth /  
Foundation ledge

Waste Gates

Type  
Number: Size ft. high x ft. wide  
Elevation Invert: Total Area sq. ft.  
Hoist

Waste Gates Conduit

Number: Materials  
Size ft.: Length ft.: Area sq. ft.

Embankment

Type  
Height—Max. ft.: Min. ft.  
Top—Width: Elev. ft.  
Slopes—Upstream on: Downstream on  
Length—Right of Spillway: Left of Spillway

Spillway

Materials of Construction  
Length—Total ft.: Net ft.  
Height of permanent section—Max. 30 ft.: Min. ft.  
Flashboards—Type Removable 46 1/2": Height ft.  
Elevation—Permanent Crest: Top of Flashboard  
Flood Capacity 3.55 cfs.: 13.6 cfs/sq. mi.

Abutments

Materials:  
Freeboard: Max. 3 ft.: Min. ft.

Headworks to Power Level.—(See "Data on Power Development")

OWNER Rockingham Water Control Co. Inc. N. H. Line & Electric Co.

REMARKS

Going to repair canal on right side and abutment on the  
left side

Tabulation By ESV Subject to inspection Date April 14, 1959

# NEW HAMPSHIRE WATER CONTROL COMMISSION DATA ON WATER POWER DEVELOPMENTS IN NEW HAMPSHIRE

## LOCATION

AT DAM NO. 172.01

Town Hampton: County Rockingham  
Stream Hampton R.  
Basin-Primary Coastal: Secondary Blackstone  
Local Name

## GENERAL DATA

Head-Max. .... ft.: Min. .... ft.: Ave. 25' .... ft.  
Date of Construction .....: Use of Power Industrial  
Pondage ..... ac. ft.: Storage ..... ac. ft.

## DESCRIPTION

### Racks

Size of Rack Opening .....  
Size of Bar .....: Material .....  
Area: Gross ..... Sq. Ft.: Net ..... sq. ft.

### Head Gates

Type .....  
Number .....: Size ..... ft. high x ..... ft. wide  
Elevation of Invert .....: Total Area ..... sq. ft.  
Hoist .....

### Penstock

Number .....: Material .....  
Size .....: Length .....

### Turbines

Number .....: Makers 1-Rodney Hunt Twin not used  
Rating HP. per unit .....: Total Capacity 884 HP.  
Max. Dement C.F.S., per unit .....: Total ..... cfs.

### Drive

Type .....

### Generator

Number 2 350 Kw 600 v 400 R 267 RPM (3 Phase)  
Make 1 Westinghouse 375 kw 600 v 1-G.E 350kw 600v 326 A 275 RPM  
Rating KW., per unit .....: Total Capacity 725 K. W.

### Exciter

Number .....: Make .....  
Rating-per unit .....: Total Capacity ..... K. W.

## OUTPUT—KWHRS

19.....	.....	19.....	.....
19.....	.....	19.....	.....
19.....	.....	19.....	.....
19.....	.....	19.....	.....
19.....	.....	19.....	.....

## OWNER

Hampton Gas and Electric Co.

Tabulation By ..... Date .....

NEW HAMPSHIRE WATER CONTROL COMMISSION

REPORT ON DAM INSPECTION

TOWN Newmarket DAM NO. 177.1 STREAM Lamprey River  
OWNER N.H. G. & E. Co. ADDRESS Newmarket, N.H.

In accordance with Section 20 of Chapter 133, Laws of 1937, the above dam was inspected by me on 7/27/54 accompanied by Supt. H. Wilson

NOTES ON PHYSICAL CONDITION

Abutments Left bank downstream  
about 5' high - good - no water - moderate amount  
Spillway Five - stone look good and light best  
good joints - no leakage

Gate Gates Good - electric motor operation - well maintained

Foundation - Good

CHANGES SINCE LAST INSPECTION

Detained, gate opened right  
date

FUTURE INSPECTIONS

Yes

This dam (is) (~~is~~) a menace because of danger since to  
sidings buildings down stream from dam

REMARKS

Have reinforced walls on West (right) canal below power station,  
by possession of concrete blocks up to main station inspected by  
N.H. G. & E. Co. party

Copy to Owner	Date

H. Wilson  
INSPECTOR

(Additional Notes Over)

NEW HAMPSHIRE WATER RESOURCES BOARD

INSPECTION REPORT

Town: View market Dam Number: 177.0j

Name of Dam, Stream and/or Water Body: Lumprey River

Owner: Essex Int Inc Telephone Number: 603 5555

Mailing Address: Norwood

Max. Height of Dam: 30' Pond Area: 5 A Length of Dam: 150'±

FOUNDATION: beds

OUTLET WORKS:

72' overflow spillway Had 3' 9" Flashboards

No. Flashboards

6' Freeboard

3 waste gates

ABUTMENTS: Cut Stone

EMBANKMENT:

SPILLWAY:

Length: 72'

Freeboard: 6'

SEEPAGE:

Location, estimated quantity, etc.

None Noted

Changes Since Construction or Last Inspection:

Tail Water Conditions:

Overall Condition of Dam: Good

Contact With Owner: No

Date of Inspection: 20 Apr 77

Suggested Reinspection Date 1982

Class of Dam: Minor A

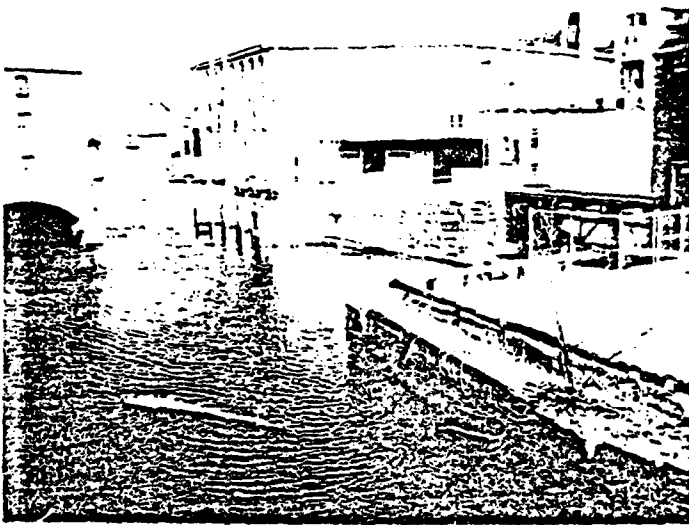
Signature S. B. Smith

Date \_\_\_\_\_

Note: Give Sizing, Condition and detailed description for each item, if applicable.

COMMENTS:

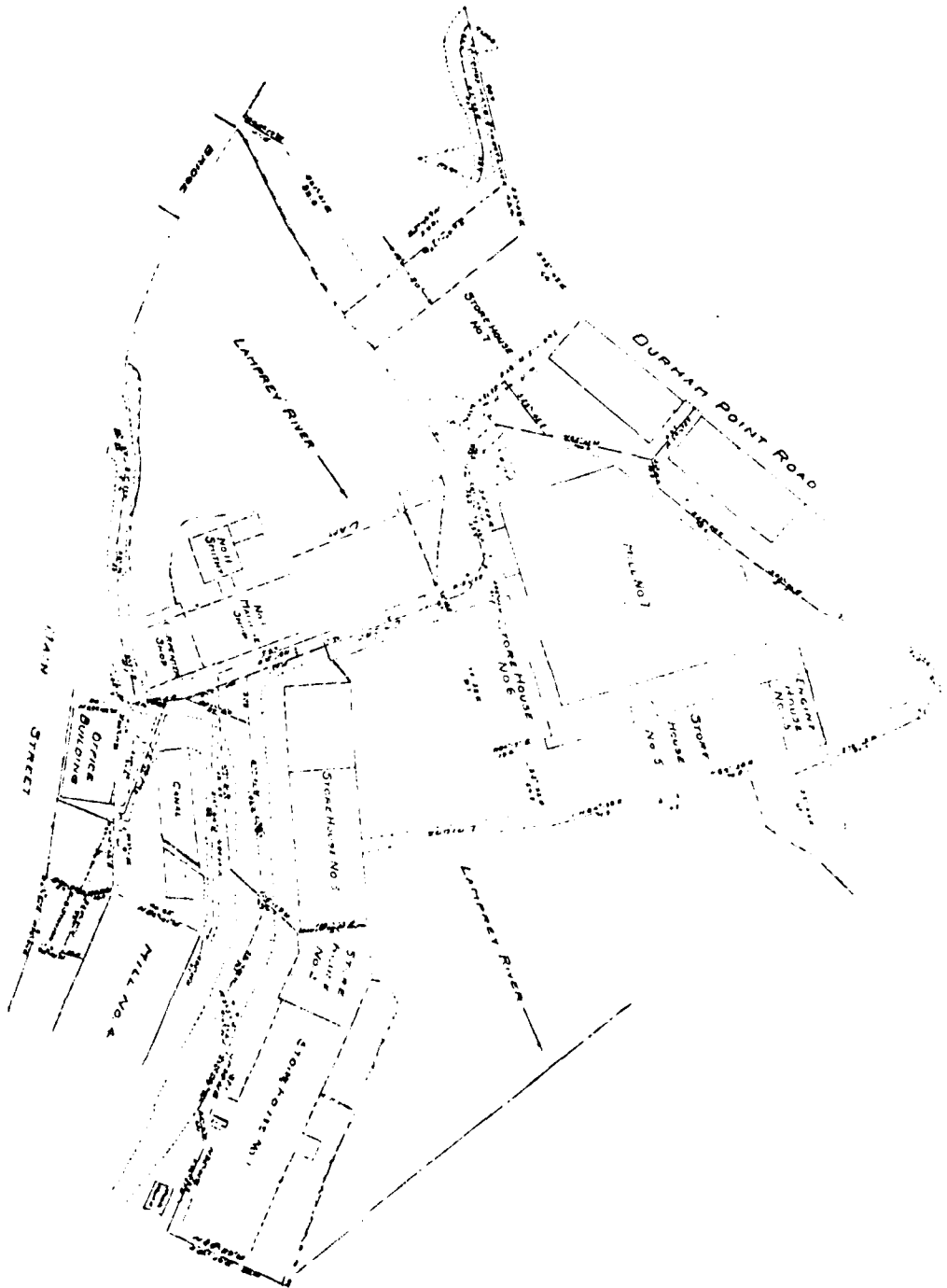
This dam has a fish ladder



SKETCH OF DAM

(Show Plan, Elevation & Cross Sections)

Divided Lines shown  
 View of Map & section



NEWARK & CO.  
 WATER POWER PLANT  
 3000th Street, New York  
 State, New York  
 10000





# APPENDIX C - PHOTOGRAPHS

				<u>Page</u>
<u>LOCATION PLAN</u>				
Site Plan Sketch				C-1
<u>PHOTOGRAPHS</u>				
<u>No.</u>	<u>Title</u>	<u>Roll</u>	<u>Frame</u>	<u>Page</u>
1.	Overview of Macallen Dam showing upstream side	16	14	vi
2.	Left side of dam, upstream	16	15	C-2
3.	Right side of dam, upstream	16	8	C-2
4.	Downstream channel and left side of dam	16	18	C-3
5.	Outlet works at left abutment	16	0	C-3
6.	Downstream channel and right side of dam	16	17	C-4
7.	Fishladder at right side of dam	16	3A	C-4
8.	Operation of outlet works gate	16	5A	C-5
9.	Masonry at left spillway abutment	16	10	C-5
10.	Approach channel and Route 108 bridge upstream of dam	16	20	C-6
11.	Downstream channel and covered access bridge	16	2A	C-6

LAMPREY RIVER  
TO  
GREAT BAY  
(TIDAL)

ABANDONED  
TAILRACE

OLD MILL BUILDINGS

(6) COVERED FOOTBRIDGE (4)

ESSEX GROUP SUBSIDIARY  
OF UNITED TECHNOLOGIES  
(MACALLEN COMPANY)

PARKING AREA  
AREA OF  
SEEPAGE

BRIDGE

PROPERTY N.H. FISH  
AND GAME DEPT.

FISH LAAGER

OUTLET WORKS

LEFT SIDE

ABANDONED INTAKE  
AND CANAL

RIGHT SIDE

LAMPREY RIVER  
(EL 101.7 ASSUMED DATUM)

OLD MILL BUILDING

Macallen Dam  
Newmarket, NH

SITE PLAN SKETCH

Approx. Scale: 1" = 40'

April 1980

HALEY & ALDRICH, INC.  
LAMPREY'S WATERWAYS

NOTE  
PLAN DEVELOPED FROM "NEWMARKET MFG. CO.  
WATER POWER PROPERTY, SHOWING DIVISION  
LINES AND RIGHTS OF WAY", BY JOHN W. DURGIN,  
DATED 19 SEPTEMBER 1933 (SEE PAGE B-10),  
"PROPOSED LAMPREY RIVER FISHLAAGER,  
NEWMARKET, N.H.", BY NEW HAMPSHIRE FISH &  
GAME DEPARTMENT, DATED JANUARY 1971  
(SEE PAGE B-11) AND FIELD OBSERVATIONS  
MADE ON 16 NOVEMBER 1979.

LEGEND

(2) PHOTO NUMBER AND DIRECTION OF  
VIEW

1 2 3

4454 B36



2. Left side of dam, upstream



3. Right side of dam, upstream



4. Downstream channel and left side of dam



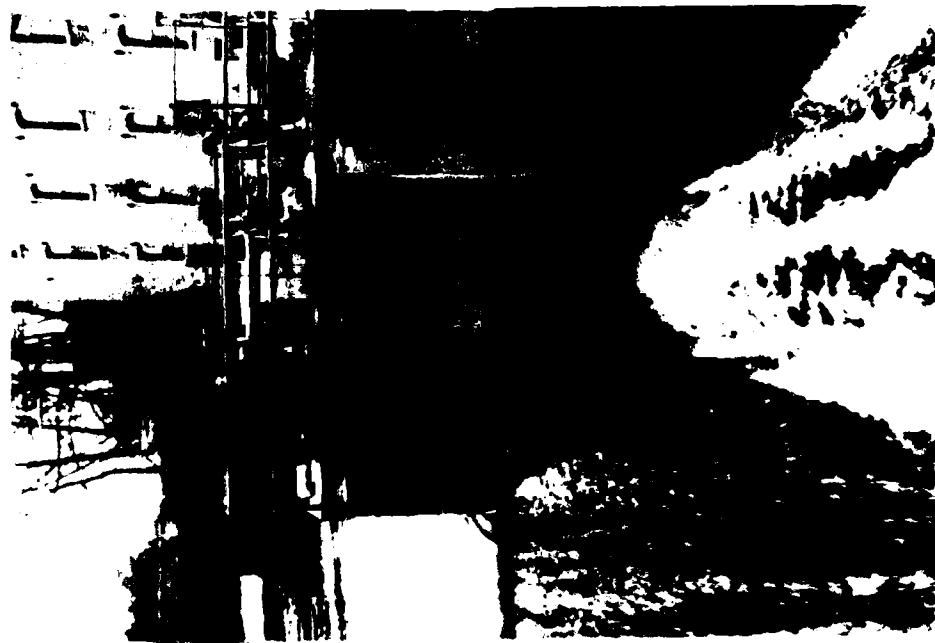
5. Outlet works at left abutment



6. Downstream channel and right side of dam



7. Fishladder at right side of dam



8. Operation of outlet works gate



9. Masonry at left spillway abutment



10. Approach channel and Route 108 bridge upstream of dam



11. Downstream channel and covered access bridge



## APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS

### MAPS

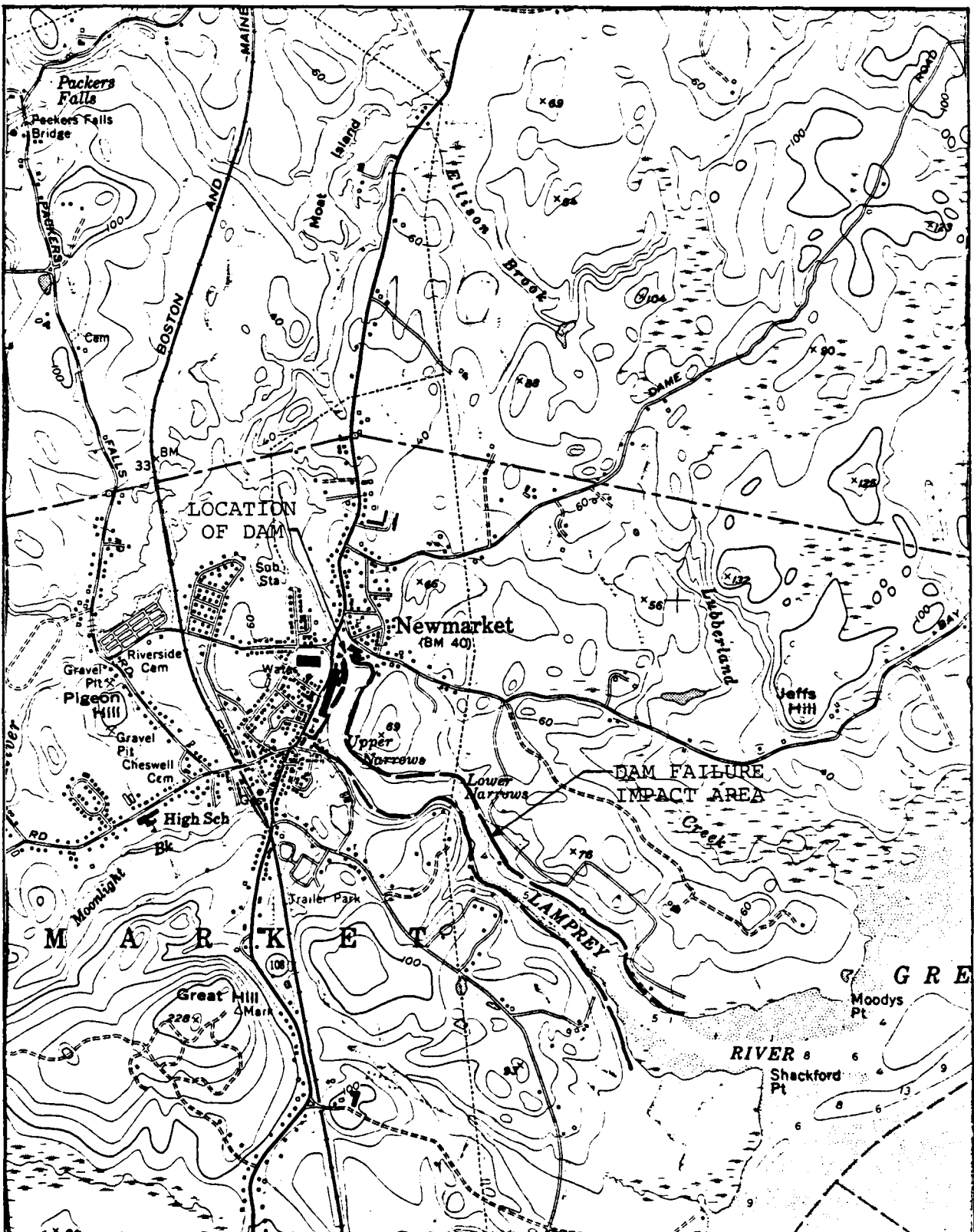
### Page

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Dam Failure Impact Area Map	D-2

### COMPUTATIONS

Elevations, Surface Areas and Storage Capacities	D-3
Size Classification, Hazard Classification and Test Flood Determination	D-4
Stage-Discharge Relationships	D-5
Stage-Discharge and Storage-Elevation Curves	D-7
Surcharge-Storage Routing	D-8
Dam Failure Analysis	D-9





MACALLEN DAM  
NH 00365



DAM FAILURE IMPACT  
AREA MAP

APPROX. SCALE: 1" = 2000'

CLIENT HALEY & ALDRICH  
 PROJECT DAM INSP  
 DETAIL MACALLEN DAM
JOB NO. 561-10-RT-7COMPUTED BY JEDDATE CHECKED 2-28-80DATE 2/4/80CHECKED BY Lee A.PAGE NO. 1ELEVATIONS (Local Datum)

Top of Dam (right abutment) = El. 105.9  
 Top of Platform for Outlet Works (left abutment) = El. 107.7  
 U/S Invert of Outlet Works El. 92.7  
 Spillway Crest El. 100.0  
 Toe of Dam El. 79.0

SURFACE AREAS

D.A. at USGS Gaging Sta. 01073500 located on Lamprey River approx. 2.7 miles U/S of Macallen Dam (200' U/S of Packers Falls) is 183 mi<sup>2</sup>; (source: USGS)

D.A. at mouth of Lamprey River (Great Bay) is 211 mi<sup>2</sup>; (source: NH Water Supply & Pollution Control Commission)

D.A. at Dam is 210 mi<sup>2</sup>; (source: Public Service Comm. of N.H., Assoc. Gas & Light Co., and NHWRB)

The Macallen Dam is a run-of-river dam having no associated U/S pond. However, the dam controls the level of the river U/S to Packers Falls, a distance of about 2.6 miles. There are several oxbows in the reach and the available storage is large.

Normal W.S. area at El. 100.0 = 120 acres

Estimated area at El. 106.0 = 300 acres

STORAGE CAPACITIES

Water depth of Lamprey River at dam site with level at spillway crest (normal depth) is ~ 8 ft. Assume average depth of river between dam and Packers Falls to be 4 ft.

then normal storage (Elev. 100) =  $120 \times 4 = 480$  ac-ft.

and storage at top of dam (El. 106)  
 $= 480 + \frac{120 + 300}{2} \times 6 = 1740$  ac-ft.

SIZE CLASSIFICATION

$$\text{Height} = 105.9 - 79.0 = 26.9 \text{ ft.}$$

$$\text{storage at top of dam} = 1740 \text{ ac-ft.}$$

$\therefore$  Size classification is INTERMEDIATE based on storage capacity

HAZARD CLASSIFICATION

Based on the results of the dam failure analysis, a failure would result in the loss of a few lives.

$\therefore$  Hazard Classification is SIGNIFICANT

TEST FLOOD DETERMINATION

For an Intermediate size and Significant hazard, COE Guidelines give test flood range of  $1/2$  PMF to PMF (Probable Maximum Flood). Since size is near low end of classification range, adopt  $1/2$  PMF for test flood.

The Lamprey River above the Macallen Dam has a total length of about 40 miles, a total fall of almost 600 ft. and a drainage area of 210 sq. mi. The watershed is Flat & COASTAL with large amounts of natural flood plain storage.

Based on COE Guidelines for determining PMF and assuming the watershed to be similar to the Charles River (D.A. = 184 sq. mi.; PMF = 65 csm) adopt  $1/2$  PMF inflow rate of 35 csm.

$$\text{then test flood inflow} = 210 \text{ sq. mi.} \times 35 \text{ csm} = 7,350 \text{ cfs.}$$

CLIENT HALEY & HEDRICH  
 PROJECT DAM INSP  
 DETAIL MICHIGAN DAM
JOB NO. 5d-10-RJ-7DATE CHECKED 2-28-80CHECKED BY Joe A.COMPUTED BY JEDDATE 2/5/80PAGE NO 3STAGE-DISCHARGE RELATIONSHIPS

Normal operating procedure is to open the waste gates in response to flow. While there are no formal procedures for the regulation of the gates, the general procedure, according to the operator, is as follows:

When head over spillway is approx. 18", open one gate so as to maintain 12" head over spillway. If unable to achieve 12", open second gate. If head continues to rise, open all three gates.

For the purpose of this investigation, assume the following sequence of gate operation:

W.S. Elev.	Assumed Gate Operation
100.0	All gates closed
101.5	One gate open'd
102.0	Two gates open'd
102.5	Three gates open'd

Size of Gates: 7.0' x 7.0'

Inv. of Gates: El. 92.7

$$\text{Discharge thru one gate} = Q_g = CA(2gh)^{1/2}$$

where  $C = 0.85$

$A = 7 \times 7 = 49 \text{ sq. ft.}$

$h = \text{W.S. El.} - 92.7 + 3.5'$

Spillway Crest Length = 68 ft.

$$\text{Spillway discharge} = Q_s = CLH^{3/2}$$

where  $C = \text{varies with } h$

$L = 68 \text{ ft.}$

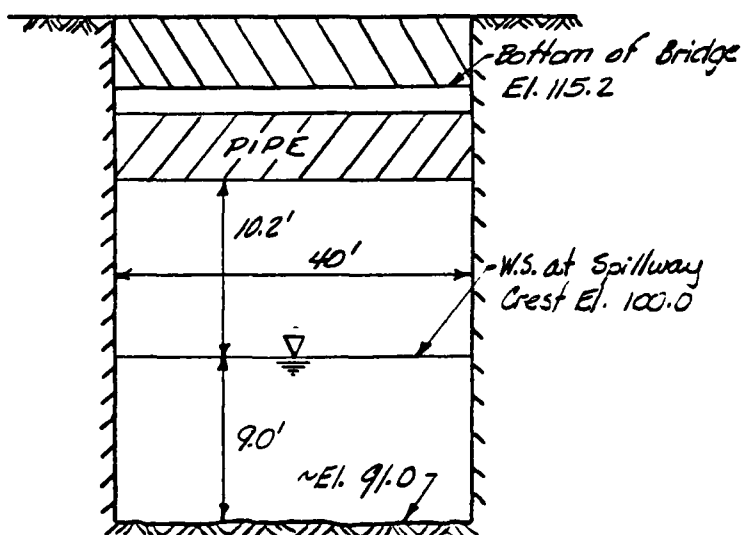
$h = \text{W.S. El.} - 100.0$

$$\text{Project Discharge} = Q_s + Q_g \times (\text{no. of gates open})$$

W.S. ELEV.	SPILLWAY			OUTLET WORKS			TOTAL Q (cfs)
	H	C	Q (cfs)	No.	H	Q (cfs)	
100.0	0	-	0	0	-	-	0
101.0	1	2.9	200	0	4.8	0	200
101.5	1.5	3.0	370	1	5.3	770	370/1140*
102.0	2	3.1	600	2	5.8	1610	1405/2210*
102.5	2.5	3.2	860	3	6.3	2520	2540/3380*
103.0	3	3.3	1170	3	6.8	2610	3780
104.0	4	3.5	1900	3	7.8	2800	4700
105.0	5	3.6	2740	3	8.8	2970	5710
105.9	5.9	3.7	3600	3	9.7	3120	6720
106.5	6.5	3.7	4170	3	10.3	3220	7390

\* Incremental opening of waste gates

Consider Route 108 Bridge approx. 350 ft. U/S of Dam:



Let W.S. @ Dam  
= El. 105.9  
Assume W.S. @  
Bridge = El. 106.0

Depth of Flow @  
Bridge = 15 ft.  
 $A = 15 \times 40 = 600 \text{ s.f.}$

$Q = 7240 \text{ cfs}$

$\therefore V_1 = 7240/600$   
 $= 12 \text{ fps}$

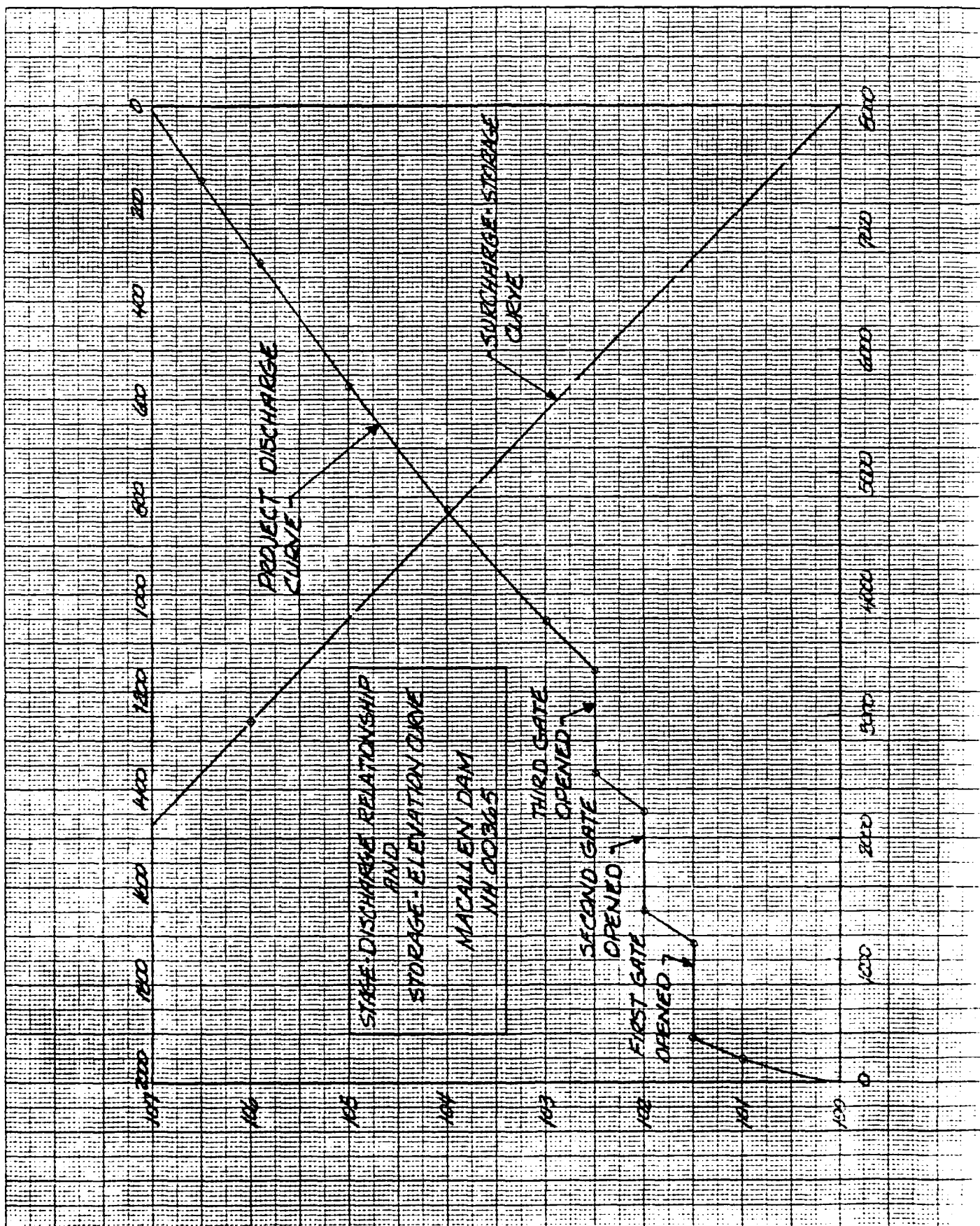
$V_1^2/2g = 2.24 \text{ ft.}$

The width of the spillway approach channel is  
approx. 100'.

$A = 15' \times 100' = 1500 \text{ s.f.}$   
 $V_2 = 7240/1500 = 4.8 \text{ fps}$   
 $V_2^2/2g = 0.36$

then  $V_1^2/2g - V_2^2/2g \approx 2 \text{ ft.}$

In very general terms, the constriction at Rt 108 during full spillway discharges will result in W.S. U/S of Rt 108 of approx. 2 ft. greater than the pool level between Rt. 108 and the dam.





SURCHARGE - STORAGE ROUTING

$$\text{Test Flood Inflow} = 7,350 \text{ cfs} = Q_{p1}$$

$$\text{Surcharge Ht. to pass } Q_{p1} = 106.46$$

$$STOR_1 = \frac{1360 \text{ ac-ft.} \times 12 \text{"/ft.}}{210 \text{ mi}^2 \times 640 \text{ ac/mi}^2} = \frac{1360}{11200} = 0.121 \text{''}$$

$$Q_{p2} = Q_{p1} \left(1 - \frac{STOR}{9.5}\right) = 7350 \left(1 - \frac{0.120}{9.5}\right) = 7260 \text{ cfs}$$

$$\text{Surcharge Height to pass } Q_{p2} = 106.4$$

$$STOR_2 = 1340 \text{ ac-ft.} / 11200 = 0.120 \text{''}$$

$$STOR_A = \frac{0.121 + 0.120}{2} = 0.120 \text{''}$$

$$Q_{p3} = 7350 \left(1 - 0.120/9.5\right) = 7,260, \text{ say } 7,250 \text{ cfs}$$

$$\text{TEST FLOOD INFLOW} = 7,350 \text{ cfs}$$

$$\text{ROUTED TEST FLOOD OUTFLOW} = 7,250 \text{ cfs}$$

$$\text{TEST FLOOD ELEVATION} = 106.4$$

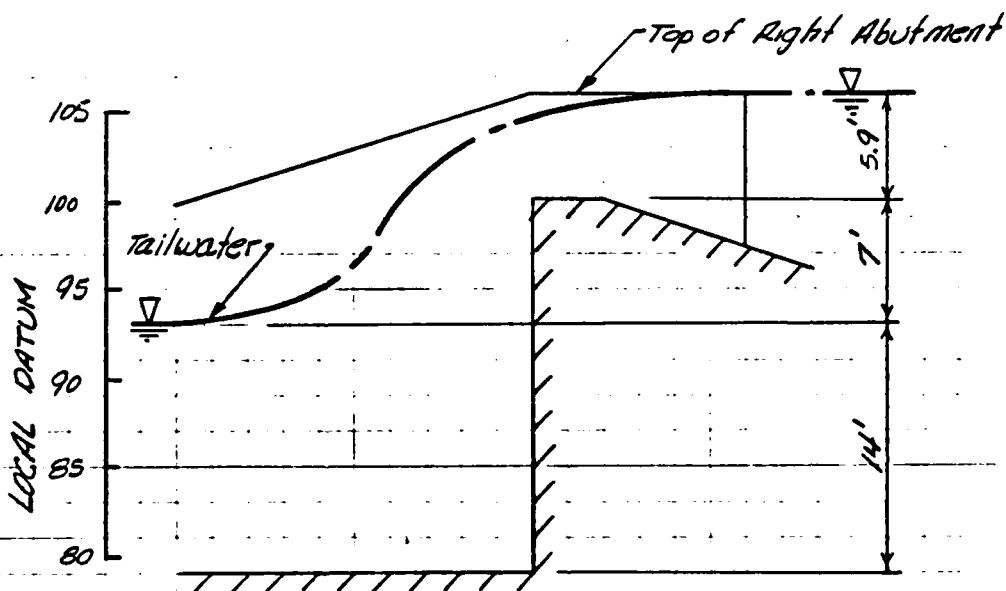
### DAM FAILURE ANALYSIS

Elevations on local datum:

Spillway Crest Elev. 100.0  
" " Length = 68 ft.  
Toe of Spillway Elev. 79.0  
Top of Dam Elev. 105.9 (right abutment)

Project discharge prior to failure = 7,240 cfs (from page 4)

The dam operator reports that the tailwater corresponding to a full spillway discharge is approx. equal to the invert of the wastegates.



If the upper 7' of the spillway were to fail, the total peak failure out flow would be

$$Q_{P1} = 3.0 \times 68 \times (5.9 + 7.0)^{1.5} = 9,450 \text{ cfs}$$

Maximum recorded flood was ~ 5,500 cfs on 3/20/34  
at USGS Gage ~ 2.7 mi. ups of dam

The Lamprey River, d/s of the damsite is tidal for approx. 8,000 ft. before joining Great Bay.

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PROJECT MACHALLAN DAM  
DETAIL DAM FAILUREJOB NO 5d-10-RT-7  
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Existing development d/s of the dam, which is not located on high ground, would be flooded prior to failure by the project discharge of 7,240 cfs. The increase in discharge of about 2,200 cfs resulting from a dam failure would not significantly increase the potential for loss of life along the d/s channel other than immediately d/s of the dam in the center of Newmarket.

Assuming that a dam failure would not cause significant structural damage to the owner's mill buildings, the potential loss of life would be a few lives in two to three structures located on the right bank immediately d/s of the owner's mill.

APPENDIX E - INFORMATION AS CONTAINED IN THE  
NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

**END**

**FILMED**

**8-85**

**DTIC**